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US 4212598 A US 4173431 A US 4115034 A

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WCR  
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35/00 35/01 35/02 35/04 37/00  
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(54) Road apparatus

(57) Energy generated by a motor vehicle "a" which runs on a road surface "A" (see Fig. 2) is utilized by the apparatus which is made up of a plurality of beam members 1, piston cylinders 3, and an accumulator 14. The beam members 1 constitute the road surface "A" and are movable downwards against urging forces of springs 2. The piston cylinders 3 are disposed under each of the beam members 1 such that it can be moved downwards by the downward movement of each beam member 1 against the springs 2 when the motor vehicle "a" runs over them and can be moved upwards by the spring 2 when it has run over them. The air thus compressed in the piston cylinders 3 is sent to the accumulator 14 for utilizing it as a driving power source for generating electric power in a generator 17, etc.

FIG. 1

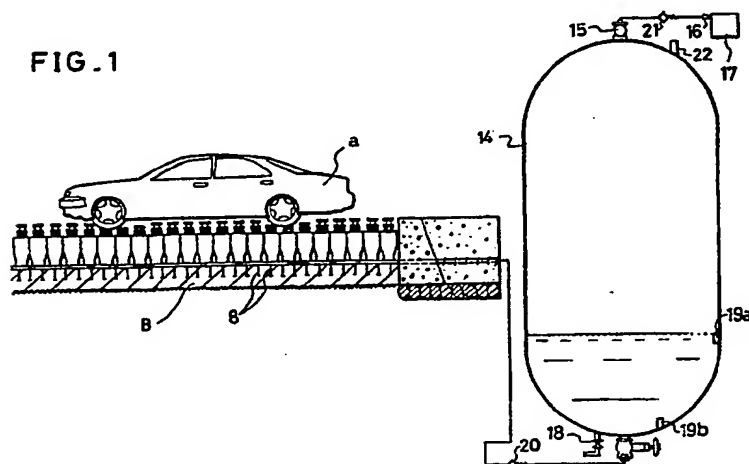
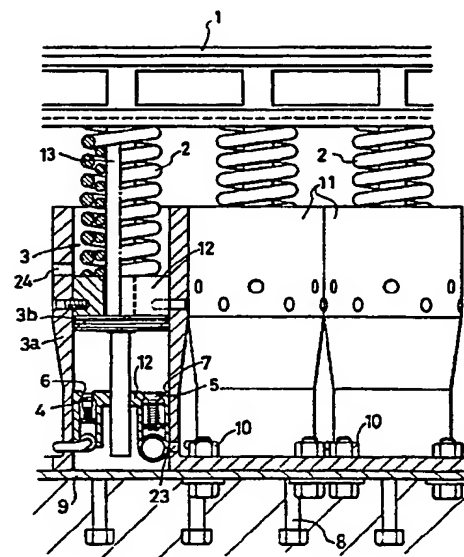


FIG. 3



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FIG . 2

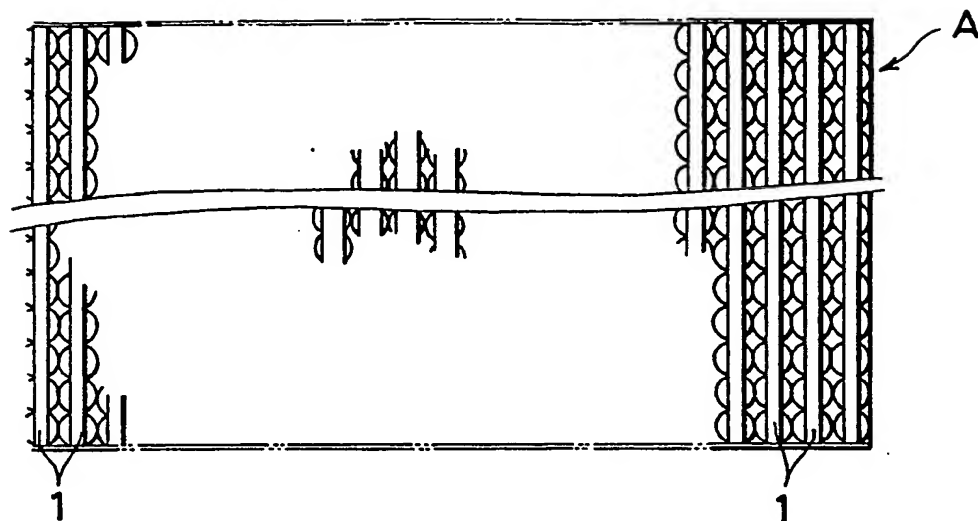


FIG . 4

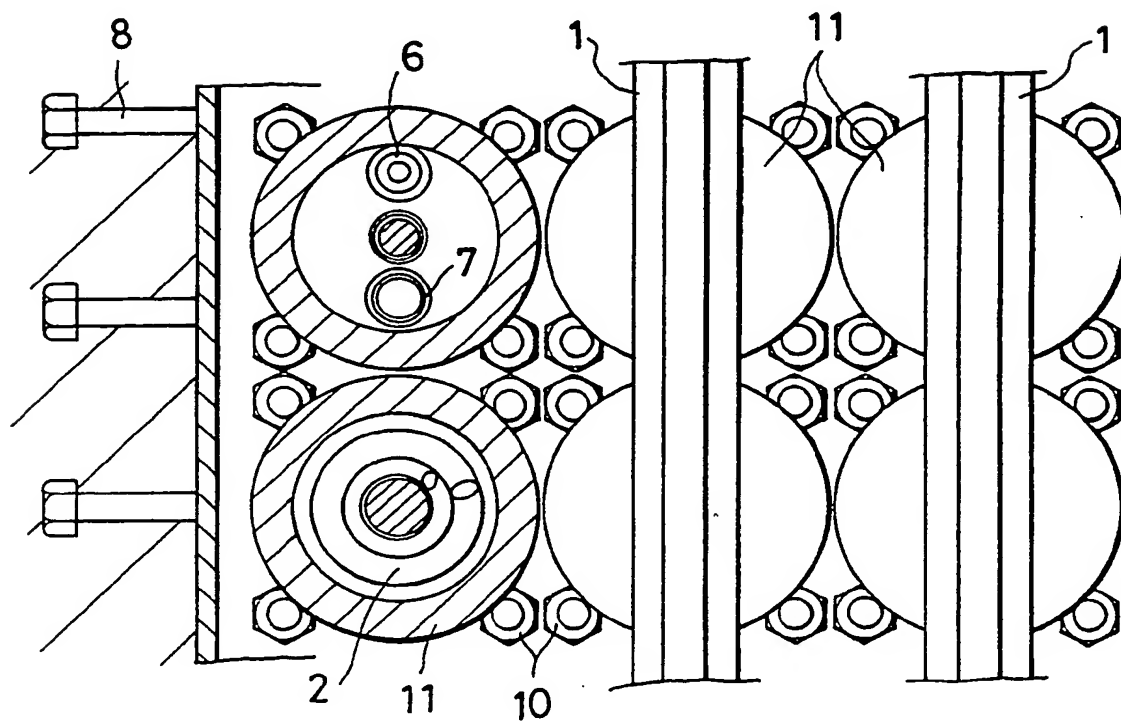


FIG. 3

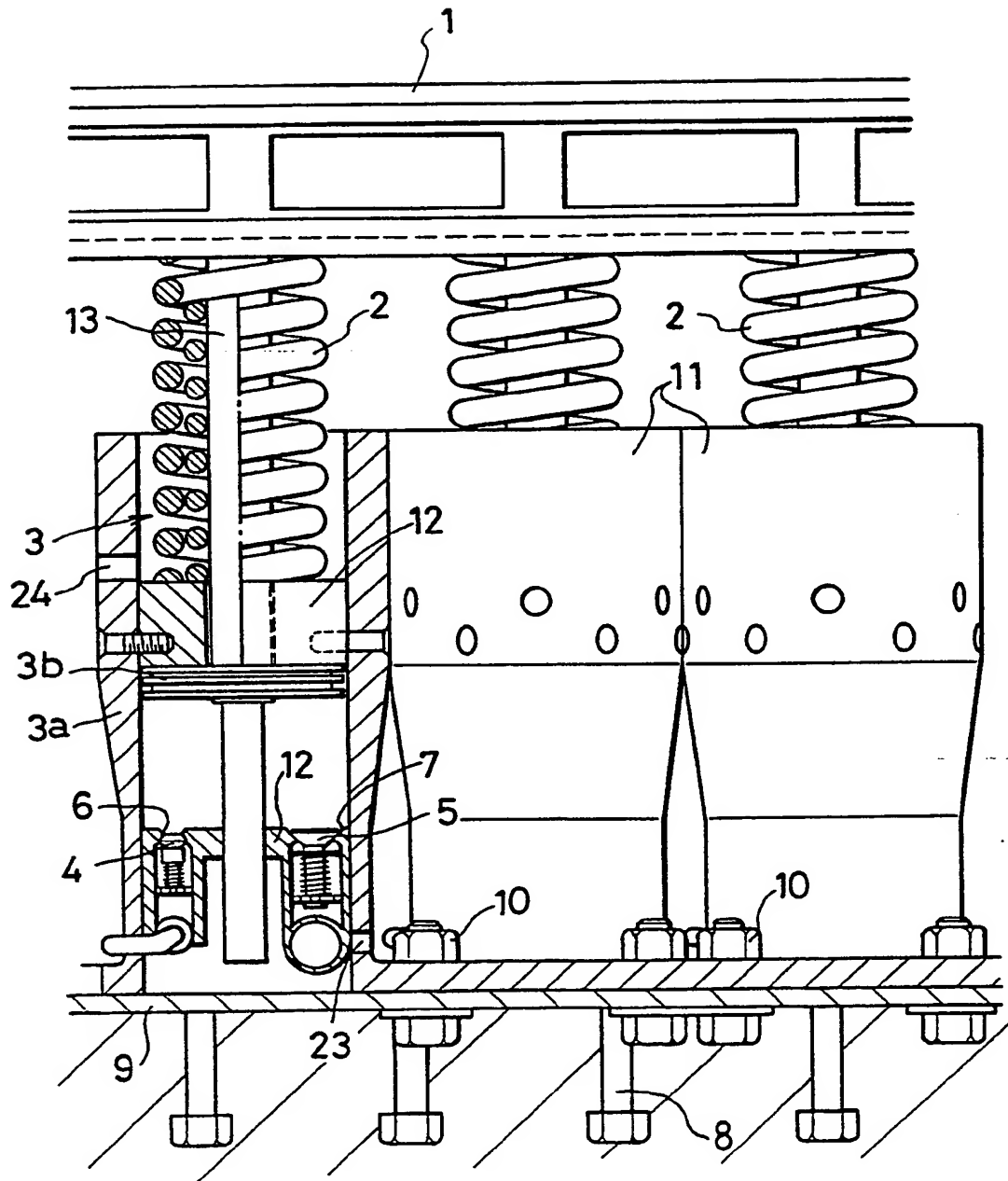


FIG. 5

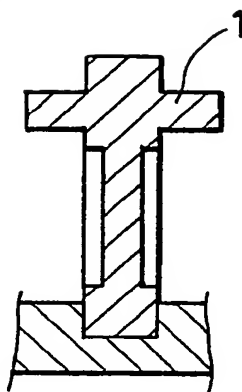
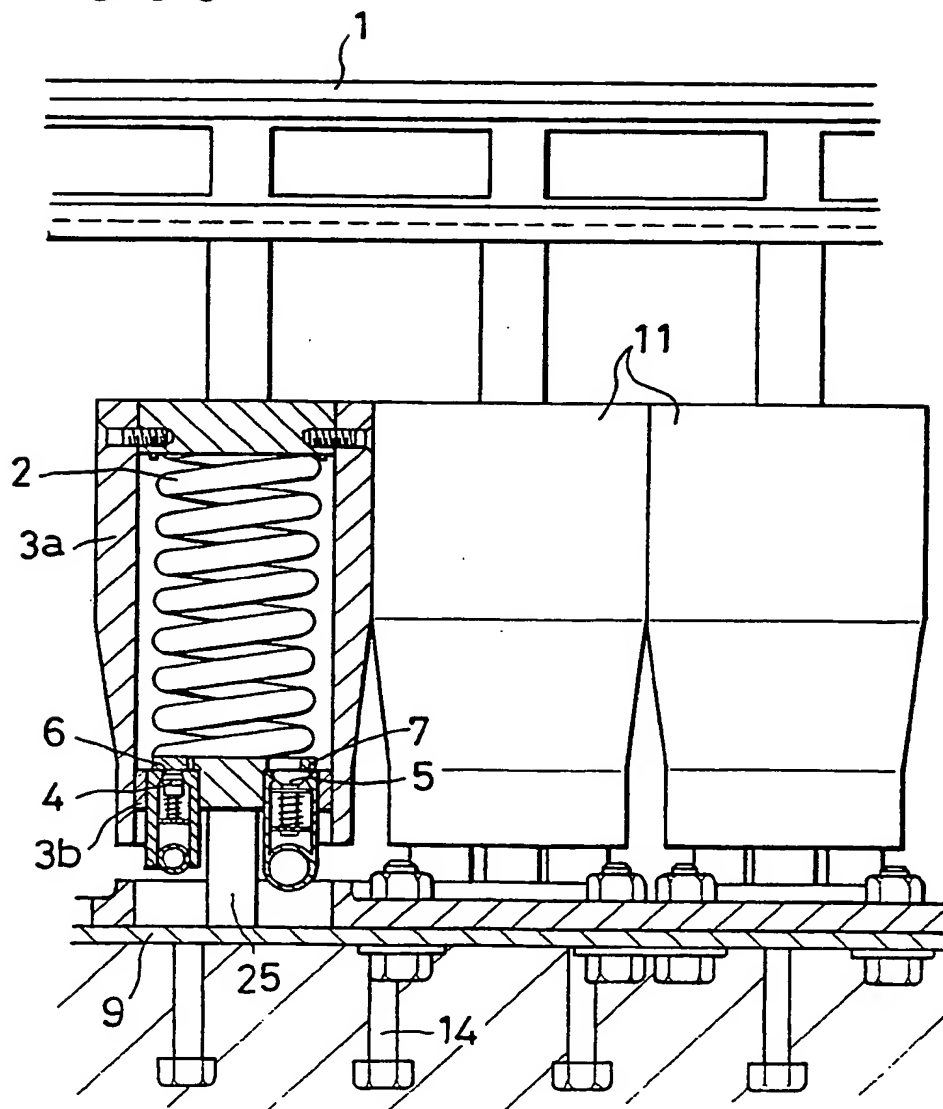


FIG. 6



ROAD APPARATUS

The present invention relates to a road apparatus for generating an energy by utilizing the change of weight of motor vehicles running on a road surface.

5 The number of motor vehicles to run on the road surface is extremely large and the energy to be exerted by the running of those motor vehicles on the road surface is enormous. Nevertheless, there has hitherto been no art of utilizing this energy.

10 The present invention has an object of providing a road apparatus in which an energy is generated by utilizing the weight of the motor vehicles which run on the road surface.

15 In order to attain the above and other objects, the present invention is a road apparatus for utilizing energy to be generated by a motor vehicle which runs thereon, comprising: means for generating compressed air by a weight of the motor vehicle; means for storing the compressed air; and means for utilizing the compressed  
20 air.

Preferably, the means for generating compressed air comprises: a plurality of beam members which constitute a road surface and which are moved down against urging forces of springs; a piston cylinder mechanism which is  
25 disposed under each of the beam members such that it can be moved downwards by the downward movement of each of the beam members against a spring and can be moved upwards by the spring, the piston cylinder mechanism having an air supply port and an air discharge port; and an air supply  
30 valve which is disposed in said air supply port and an air discharge valve which is disposed in the air discharge port.

The means for storing the compressed air preferably is an accumulator, and the means for utilizing the  
35 compressed air is an electric generator for generating

electric power or a ventilating system for ventilating a tunnel.

5 In the road apparatus having the above-described arrangement, when a motor vehicle is placed on a certain set of beam members, the corresponding beam members are pushed down against the relevant springs. As a result, the air inside the corresponding cylinders (or cylinder mechanisms) is discharged out of the cylinders by the corresponding pistons. When the motor vehicle moves to 10 the next set of beam members from the previous set of beam members, the previous beam members are moved upwards by means of the corresponding springs. By the upward movement of the pistons as the result of the above-described movement, air is sucked into the corresponding cylinders through the air supply ports. By repeating the 15 above-described operations, the air can be discharged out of the air discharge ports of the cylinders.

For a better understanding of the present invention and to show how it can be carried into effect, reference 20 will now be made by way of example to the accompanying drawings in which:

Fig. 1 is a side view showing one example of embodying the present invention;

Fig. 2 is a plan view thereof;

25 Fig. 3 is a side view, partly cut away, of an important portion thereof;

Fig. 4 is an enlarged view of part of the plan view;

Fig. 5 is a sectional view of a beam member; and

Fig. 6 is a side view, partly cut away, of another 30 embodying example of the present invention.

An explanation will now be made about preferred embodiments with reference to the accompanying drawings.

In Fig. 2, alphabet A denotes a road surface which is constituted by laying a large number of beam members 1. 35 Each of the beam members 1 is made up of an H-shaped steel

which extends in a direction perpendicular to the direction of the road. Each of the beam members 1 is disposed so as to be movable up and down against springs 2.

5        Numeral 3 denotes a piston cylinder mechanism which is provided in a plurality of rows along the longitudinal direction of each beam 1. Numerals 4 and 5 denote an air supply valve and an air discharge valve which are respectively provided in an air intake port 6 and an air discharge port 7 of each of the piston cylinder mechanism 3.

15        An explanation will now be made in more detail with reference to an example shown in Figs. 1 through 5. On a base plate 9 which is fixed to a foundation B by means of anchor bolts 8, there are mounted a plurality of cylindrical bodies 11 by means of bolts and nuts 10. Each of the cylindrical bodies 11 is divided by partition plates 12, 12 which are disposed in an upper and lower pair inside the cylindrical body 11 at a distance from each other so that a cylinder 3a of the piston cylinder mechanism 3 can be formed inside the cylindrical body 11. Further, the air supply port 6 and the air discharge port 7 are provided in the lower partition plate 12, and the air supply valve 4 is positioned in the air supply port 6 and the air discharge valve 5 is disposed in the air discharge port 7. A piston rod 13 is mounted so as to pass through the pair of the upper and the lower partition plates 12, 12. A piston 3b is mounted in that position of the piston rod 13 which lies inside the cylinder 3a. A coil spring 2 is disposed around the piston rod 13 so as to extend between the upper surface of the upper partition plate 12 and the lower surface of the beam member 1.

30        In the above-described arrangement, when the motor vehicle "a" is placed on a certain set of beam members 1, this set of beam members 1 are lowered against the springs



2. As a consequence, the air inside the relevant cylinders 3a is discharged by the pistons 3b out of the air discharge ports 7. When the motor vehicle "a" moves from the above set of beam members 1 to the next set of beam members 1, the above-described set of beam members 1 are moved upwards by the urging forces of the springs 7. As a result of the upward movement of the pistons 3b, air is sucked into the relevant cylinders 3a. By repeating the above-described steps, air is sequentially discharged out of the air discharge ports 7 in a compressed manner.

The lower end of each piston rod 13 is extended towards the upper surface of the base plate 9. When an excessive load is applied to the beam members 1 or when the springs 2 have been damaged, the lower end of the piston rod 13 comes into abutment with the base plate 9. It is thus so arranged that the beam members 1 are prevented from excessively lowering in their position.

In the above-described example, an accumulator 14 is connected to the above-described air discharge ports 7 to store or accumulate the air to be discharged from the air discharge ports 7 as compressed air so that the compressed air can be utilized as a driving power source. As one example of the way of utilizing the compressed air, a nozzle 16 is attached to a compressed air take out port 15 so that an electric power generator 17 can be operated by the compressed air to be ejected out of the nozzle 16, thereby generating electric power.

If the apparatus is used for a long period of time, drain water is accumulated in the accumulator 14. In order to discharge it, there is provided a solenoid valve 18 to a drain port of the accumulator 14. Numerals 19a, 19b respectively denote an upper limit sensor and a lower limit sensor which are provided inside the accumulator 14 for detecting the upper limit and the lower limit of the drain. A control is made such that, when the upper limit

of the drain is detected by the upper limit sensor 19a, the solenoid valve 18 is opened and, when the lower limit is detected by the lower limit sensor 19b, the solenoid valve 18 is closed. The drain to be accumulated by the compressed air inside the accumulator 14 is thus discharged out of the drain discharge port. When the drain level has lowered to the lower limit sensor 19b, the solenoid valve 18 is closed. Therefore, the accumulated air thus accumulated inside the accumulator 14 can be prevented from being wastefully discharged out of the drain discharge port.

Numeral 20 denotes a check valve which is interposed between the air discharge port 7 and the accumulator 14. Numeral 21 denotes a check valve which is interposed between the compressed air take out port 15 and the nozzle 16. Numeral 22 denotes a safety valve which is provided in the accumulator 14. Numeral 23 denotes an air intake port which is provided on a lower side surface of the cylindrical body 11 and numeral 24 denotes a drain hole which is provided in a position above the upper partition plate 12 in the cylindrical body 11.

In the above example, it has been arranged that several air discharge ports 7 of the piston cylinder mechanisms 3 are connected in a lump to a single accumulator 14. It may, however, be arranged that each air discharge port 7 of each piston cylinder mechanism 3 is respectively connected to one accumulator 14.

As another way of utilizing the energy, the following may also be considered. Namely, the apparatus according to the present invention is laid out inside a tunnel. The air intake port 3 of each of the piston cylinder mechanisms 3 is connected to an air intake pipe (not illustrated) which opens into the tunnel. The air discharge ports 7 are connected to an air blowing port (not illustrated) which is connected to the tunnel via the

accumulator 13. The apparatus can thus be utilized as an apparatus for ventilating the air inside the tunnel.

5 In the illustrated example, as a result of disposing each of the piston cylinder mechanisms 3 under each of the beam members 1 in close proximity to each other, there will be left a clearance between the front beam member and the rear (or succeeding) beam member. In order to avoid this clearance, each of the piston cylinder mechanisms 3 may be disposed at a distance from each other and the  
10 front cylinder mechanism and the rear (or succeeding) cylinder mechanism are arranged in a staggered manner. The clearance can then be eliminated.

Fig. 6 shows another example of the present invention.

15 The cylinder 3a is constituted by a cylindrical body 11 which is directly connected to the lower end of the beam member 1. On an upper end of a bar 25 which is disposed on the base member 9 so as to rise vertically upwards, there is provided a piston 3b which is inserted  
20 into the cylinder 3a from the lower end. A coil spring 2 is inserted between the piston 3b and the upper plate of the cylinder 3a, as in the above-described example. According to this arrangement, like in the above-described example, the air can be sequentially discharged out of the  
25 air discharge ports 7 by the repetition of the downward movement of the beam members 1 against the spring 2 and the upward movement thereof by the urging force of the spring 2. The air thus discharged can be stored in the accumulator 12.

30 According to the invention as described hereinabove, energy can be generated by utilizing the weight to be exerted on the road surface by the motor vehicle which runs thereon. Its construction and laying out are simple in that piston cylinder mechanisms that are operated to  
35 move downwards against the springs and to move upwards by

the springs are disposed under each beam member and that the cylinder mechanisms are provided with the air supply valves and the air discharge valves.

CLAIMS

1. A road apparatus for utilizing energy to be generated by a motor vehicle which runs thereon, comprising:

5 means for generating compressed air by a weight of the motor vehicle;

means for storing the compressed air; and

means for utilizing the compressed air.

10 2. A road apparatus according to claim 1, wherein said means for generating compressed air comprises:

a plurality of beam members which constitute a road surface and which are movable downwards against urging forces of springs;

15 a piston cylinder mechanism which is disposed under each of said beam members such that it can be moved downwards by the downward movement of each of said beam members against a spring and can be moved upwards by the spring, said piston cylinder mechanism having an air  
20 supply port and an air discharge port; and

an air supply valve which is disposed in said air supply port and an air discharge valve which is disposed in said air discharge port.

25 3. A road apparatus according to claim 1, wherein said means for storing the compressed air is an accumulator.

30 4. A road apparatus according to claim 1, wherein said means for utilizing the compressed air is an electric generator for generating electric power.

35 5. A road apparatus according to claim 1, wherein said means for utilizing the compressed air is a ventilating system for ventilating a tunnel.

6. A road apparatus substantially as hereinbefore described with reference to the accompanying drawings.

**Relevant Technical Fields**

(i) UK Cl (Ed.N) F1W: WCN, WCR, F1S; S21; F1Q: QX; B7J  
 (ii) Int Cl (Ed.6) F03G: 3/00, 5/00, 5/02, 5/06, 7/00, 7/08;  
 F04B: 35/00, 35/01, 35/02, 35/04, 37/00

Search Examiner  
 G WILLIAMS

Date of completion of Search  
 7 APRIL 1995

**Databases (see below)**

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-  
 1-5

(ii) ONLINE DATABASE: WPI

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**Y:** Document indicating lack of inventive step if combined with one or more other documents of the same category. **E:** Patent document published on or after, but with priority date earlier than, the filing date of the present application.  
**A:** Document indicating technological background and/or state of the art. **&:** Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2056388	(LOMBARDI) see Figure 1	1
X	GB 1602275	(DIXON) see page 1, lines 77-86 and Figure 1	1
A	WO 88/07135	(STITES) see whole document	1
X	US 4212598	(ENERGY DEV.) see column 3, lines 35-39, column 4, lines 7-11 and Figures 1, 2	1
X	US 4173431	(NU-WATT) see column 2, lines 42-65 and column 3, lines 29-37	1
X	US 4115034	(SMITH) see column 3, lines 14-37	1

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